

gratings can, I believe, be very much improved, as soon as some better method of printing gratings is devised. I have worked exclusively with chrom-gelatin, and it is by no means easy to get a film of such uniform thickness that the print made on it appears uniformly illuminated.

During the past summer I made some experiments with Prof. Lippmann, of Paris, on copying gratings by means of the plates which he uses in his process of colour-photography. These plates are much more sensitive than chrom-gelatin plates, are orthochromatic, and yield gratings of great brilliancy and uniformity. Whether they are capable of receiving two or more impressions remains to be seen. If they are it will probably be possible to form a diffraction colour-photograph directly in the camera, in the manner suggested in one of my earlier papers.

Moreover, if the triple ruling can be transferred in any way to the Joly taking screen, it is obvious that the *negative* taken by means of it in the camera will, when placed in the viewing apparatus, appear as a positive in natural colours; we can thus obtain our coloured positive at once in the camera, and make as many duplicates from it as we please by contact printing.

THE AGRICULTURAL EDUCATION CONFERENCE AT GLOUCESTER.

UNDER the auspices of the Gloucestershire County Council, a conference on agricultural education was held at the Shire Hall, Gloucester, on October 15. There was a large attendance not only of those locally interested in either education or agriculture, but also of delegates from many of the other counties. After a few preliminary remarks from the chairman, Sir John Dorington, Lord Onslow opened the proceedings, and explained the work his department was charged with in regard to education. He justified the retention of that work by the Board of Agriculture instead of allowing it to be merged in the general educational system administered by the Board of Education, on the plea that agriculture in England was so far from being the leading industry that the specialised education it required would get scant attention were there not his own department peculiarly interested in fostering it. He claimed that the constant and sympathetic communication between the two departments secured more favourable results than could be acquired under the Board of Education exclusively. The work of the Board of Agriculture was confined to assisting the collegiate centres under which the greater part of the country was now grouped; there was, however, a large blank on the educational map, for the whole of the west country, including Gloucestershire itself, had no centre of university rank from which agricultural instruction emanated. He trusted that the present conference would pave the way towards remedying the need he had indicated.

Sir William Hart-Dyke, to whom the first paper, on higher agricultural education, had been entrusted, was unable to be present; his paper, of which an abstract was read, warned the meeting of the difficulty that now confronted all counties in the matter of higher education because of the great draft on their funds for the future training of elementary schoolmasters.

A paper by Prof. Middleton, of Cambridge University, next dealt with the proper function of experimental plots in local agricultural education; Prof. Percival, of Reading, who followed, dealt with the ideal course of instruction in an agricultural college. The current courses, he maintained, were far too scientific; chemistry, botany and kindred sciences should be reduced to a minimum in favour of work on the farm, a thoroughly popular programme which appealed to the "practical men" in the room.

Lord Montagu then opened the second part of the proceedings, on the education of the small farmer, with an account of the way the Irish Board of Agriculture had gone to work.

In Ireland the central authority administered the larger part of the funds, contributing five-ninths of the cost of any work, and securing four-ninths from the local authority; thus the organisation proceeded more evenly over the whole country than in England, where the initiative rests with

the local authority. Next, they had proceeded in Ireland on the principle of establishing no institution until they had created a demand for it by means of pioneer lecturing and demonstrations. Lastly, in Ireland they believed that the industrial organisation of the farmers must go hand in hand with their education.

Prof. Wallace, of Edinburgh, who followed, dwelt on the necessity of beginning an agricultural training at an early age, so far as practical work on the farm went, leaving the true technical instruction to come when the lad had matured. Mr. Frederick Verney also dwelt on the harm that was being done to country children by keeping them at unsuitable school subjects until they had lost all taste for farming pursuits; the present system of elementary education contributed both to the depopulation of the country and the overcrowding of the towns.

Mr. H. Hobhouse, M.P., spoke on the value of attaching agricultural sides to the ordinary country grammar schools; the training would not be technical, but scientific with an agricultural bias.

After lunch Mr. Morant expressed his pleasure at the opportunity the conference afforded him of learning the feelings of the great agricultural community towards the educational system of the country. He assured the meeting that the Board of Education was wholly anxious to assist, provided the men who represented agriculture on such occasions would make their views precise, and, instead of grumbling at large, would indicate exactly what worked harshly or harmfully in the present arrangements controlled by the Board of Education.

A paper by Sir C. Dyke Acland was then read in his absence; it dealt with the education of the labourer, and was, like so many that followed, a plea for more intelligent teaching in our elementary schools, and for a more flexible system which would partially liberate boys at an earlier age for light work on the farm. Mr. G. Lambert, M.P., and Mr. Martin F. Sutton emphasised this point of view, and, like Mr. Acland, they agreed that in the main rural labour difficulties had been caused by keeping the rate of wages too low, with consequent loss of efficiency.

The last section of the conference, on the education of the teacher and expert, was opened by Mr. A. D. Hall, who pleaded for a more rigorous training which should include some experience in farming for the teacher of agriculture, and some work at research for the man who dealt with agricultural science. Canon Steward, principal of the Salisbury Training College, discussed more generally the education of the elementary schoolmaster and mistress in country districts, and finally, Mr. R. P. Ward gave an account of the way the teachers were being trained in Cheshire.

In the discussion which followed most of the speakers urged the substitution of winter schools or of evening continuation schools for the compulsory attendance of country boys at school up to the age of fourteen; for farming purposes a boy ought to begin light work on the farm at the age of twelve at latest, though his education should go on much later than it does now.

The conference was noteworthy not only for the quality of the papers read, but for the advance they showed in the direction of organisation on those submitted to previous conferences. It was made clear that there are several different classes to be provided for; the large farmer's son or future land agent wants a different equipment from that of the small holder; the farmer himself must be reached by an entirely different method; the labourer, again, has to be treated separately. At Gloucester the various speakers defined clearly their aim and their method; in former gatherings of the same nature the speakers seemed to consider there was only one kind of worker engaged in agriculture.

THE SPREAD OF PLAGUE.¹

IN accordance with our views on the origin of epidemics it is necessary to believe that the plague which appeared in Bombay in the autumn of 1896 was derived from some previously infected locality. Two such localities have been

¹ Substance of a paper read before the Section of Physiology at the Cambridge meeting of the British Association on August 19 by Dr. E. H. Hankin.

suggested. The most obvious suggestion is to the effect that it was derived from Hong Kong, which town had been the seat of a serious epidemic in 1894, and which in 1896 remained still infected. An alternative suggestion was put forward in the report of the German Plague Commission to the effect that it was derived from Garhwal. The suggestion was to some extent substantiated by the fact mentioned in the report in question that two thousand fakirs from Garhwal had arrived in Bombay on their way to a pilgrimage at Nassik shortly before the appearance of the disease. Plague is endemic in Garhwal (a district in the Himalaya Mountains), and this locality is therefore a possible source of infection. By conversation with a fakir who had attended the Nassik festival, Mr. Hankin learnt that the Garhwal fakirs only visit western India on occasions when the Nassik festival is being held. This festival is held regularly at twelve-yearly intervals.

It occurred to Mr. Hankin that if Garhwal was the source of the Bombay plague, by means of fakirs, it might also be the source of previous epidemics of plague in western India. On counting backwards from 1896 by twelve-yearly intervals, one arrives at 1836, the date of the Pali plague, and at 1812, the date of the Gujerat plague. That is to say, of the eight occasions on which these fakirs visited western India during the nineteenth century, on no less than three an outbreak of plague appeared. This fact may be regarded as strongly substantiating the suggestion of the German Plague Commission as to the origin of the Bombay outbreak. Further, it is stated by Forbes that the Pali plague originated in a village a few miles distant from the town of Pali shortly after the arrival of some wandering fakirs, and that it was preceded by a mortality among the rats. It was pointed out that these three plagues of western India had certain characters in common in which they differed from the majority of plagues in other parts of the world. First, they were characterised by their greater intensity and persistence; secondly, during the greater part of their course, at all events, they showed more virulence in villages than in towns; thirdly, they spread over the affected country, like a wave, from village to village, and showed but little tendency to travel along trade routes; fourthly, in each of the outbreaks the pneumonic form of the disease was frequently observed. The fact that these outbreaks resembled each other, and differed in general from outbreaks elsewhere, in the above characters, accords with the idea that they have a common origin. One apparent exception, however, which is of great importance must be described. This is the black death. So far as evidence goes, this outbreak was distinguished by each of the characters that have been ascribed to Indian plagues. In order, therefore, to be able to hold that Indian plague is of Garhwal origin, it is necessary to show that the black death may possibly have been derived from the same source.

The black death is known to have been imported into Europe from the town of Caffa, in the Crimea, where the Tartar army had been besieging some Italian merchants. According to an Arab historian, Aboul Mahasin, the plague was brought to the Tartar army from Tartary, where it was present in the year 1346, if not earlier. At that period, trade in horses and merchandise existed between India and Tartary. It is therefore necessary to investigate whether a Nassik festival occurred shortly before that time, and whether it was accompanied by an outbreak of pestilence. At first sight a study of Indian history appeared to negative the suggestion. It is stated, however, in Elphinstone's "History of India" that a rebellion broke out in Ma'bar in 1341, and that the army sent to suppress it was destroyed by plague. It appeared desirable to investigate this statement in detail. Counting back by twelve-yearly intervals, we arrive at 1344 as the year of a Nassik festival. In view of the great antiquity of Indian religious festivals, we are safe in assuming that in that year a number of fakirs emerged from Garhwal on their way to the sacred shrine. Ma'bar is situated on the Coromandel coast, on the Madras side of India, and one would expect that the army of the Emperor of Delhi would not march anywhere near to Nassik. But a contemporary history dealing with the conquest of Ma'bar, some thirty-five years previously, describes minutely the route then followed by the army. It appears to have lain through, or near, Nassik, and that the soldiers

must have marched along the same route as the fakirs for all the first part of their journey. It is further recorded that when the army was destroyed by pestilence the Emperor himself was attacked, and that when suffering from the disease he halted at Deogiri, a town close to Nassik. It appears from a contemporary history that the army originally sent in 1341 was insufficient for its purpose, that the Emperor returned for reinforcements at a time when a famine was raging in Delhi, and that it was these reinforcements that were destroyed by the pestilence. The date of the famine is given as 1344. This is also given as the date at which the campaign terminated, and at which the rebels recovered their independence. Thus we have evidence that a plague broke out near Nassik in the year 1344, at a time when Garhwal fakirs were present, and it is obvious that this plague may have been carried to Tartary in time to have been the precursor of the black death, which is first known to have been present there in the year 1346. Other suggestions as to the origin of the black death, as, for instance, that it came from China, or from the supposed endemic area in Mesopotamia, or from the then existing endemic area of the Levant, if not contradicted by known facts, are at least unsupported by any positive evidence.

Prof. G. S. Woodhead asked whether it was known to what the pneumonic form of plague was due. Was it due to extra virulence or to the climatic conditions?

Sir Edward Candy asked if the outbreaks of plague in 1812 and 1836 spread and continued in the same manner as that of 1896, which re-appeared for some time after with every return of cold weather. It was noteworthy that the plague of 1896 took hold of the country up to the Punjab, but missed out Calcutta and Madras.

In the course of his reply, Mr. Hankin pointed out that it was a remarkable fact that the pneumonic form of the disease showed but little tendency to spread as such by direct infection from person to person. Mr. Hankin had found that the plague virus lost its virulence by passages through rats. It was possible that it would also lose its virulence by passages through human beings, and that the true nidus of the disease in which it could retain or regain its virulence was to be found in some other living organism, as, for example, some species of flea. With regard to the important point raised by Sir Edward Candy as to the spread of plague, Mr. Hankin stated that it was a necessary corollary of his theory that the present outbreak of plague in India had not established itself in any other part of the world. It was probable that plague was carried from Hong Kong to Noumea, to Australia, to Madagascar, thence to South Africa, Oporto, and other localities. The present pandemic of plague was essentially a disease of sea-ports, in the first instance, and then of towns. It but rarely established itself in villages, and then always rapidly died out. In this and in other characters it showed itself distinctly different from the Indian form of the disease.

INVESTIGATIONS ON THE NUTRITION OF MAN.¹

PROF. W. O. ATWATER, Middletown, Connecticut, chief of nutrition investigators of the United States Department of Agriculture, gave an account of the inquiry regarding the food and nutrition of man which is carried out in the United States by authority of Congress. The work is done by cooperation between the Department of Agriculture and a large number of universities, experiment stations, and other organisations from Maine to California. The headquarters is at Wesleyan University, Middletown, Connecticut, where the speaker, who is in charge of the work, is situated. The Federal Government devotes 20,000 dollars (4000*l.*) a year to the enterprise. This is used mainly as aid to research, and is supplemented by grants of money and other aid from State Governments and other sources. The inquiry has three aspects, one very practical, another more purely scientific, and a third educational.

On the practical side studies are made of the composition, the digestibility, and the nutritive values of food materials

¹ Abstract of an address before the Sections of Physiology and Economics at the Cambridge meeting of the British Association on August 23.